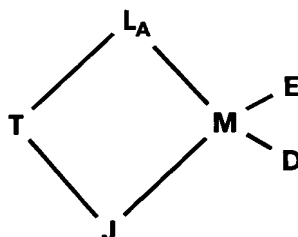
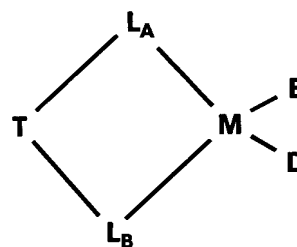
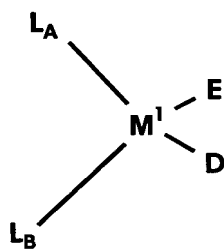


**CLAIMS**

We claim:

1. A composition comprising the product of combining, in the presence of a free radical initiator, a catalyst precursor and at least one monomer wherein the monomer is polymerizable by free-radical polymerization, and wherein the catalyst precursor is represented by one of the formulas:



wherein

- (a) M is a Group 3–10 metal;  
M<sup>I</sup> is a Group 3–10 metal;
- (b) L<sub>A</sub> is a substituted or unsubstituted, cyclopentadienyl or heterocyclopentadienyl ligand connected to M wherein L<sub>A</sub> comprises R;
- (c) L<sub>B</sub> is

- (i) a ligand as defined for  $L_A$  but selected independently of  $L_A$ , or
- (ii) J, a heteroatom ligand connected to M, wherein J comprises a Group-14-15 atom and 0-2 of  $R''$ ;
- (d) T is a bridging group that connects  $L_A$  and  $L_B$  and comprises a Group-13-to-16 element and 0-2 of  $R'$ ; and
- (e) D and E are the same or different abstractable ligands,

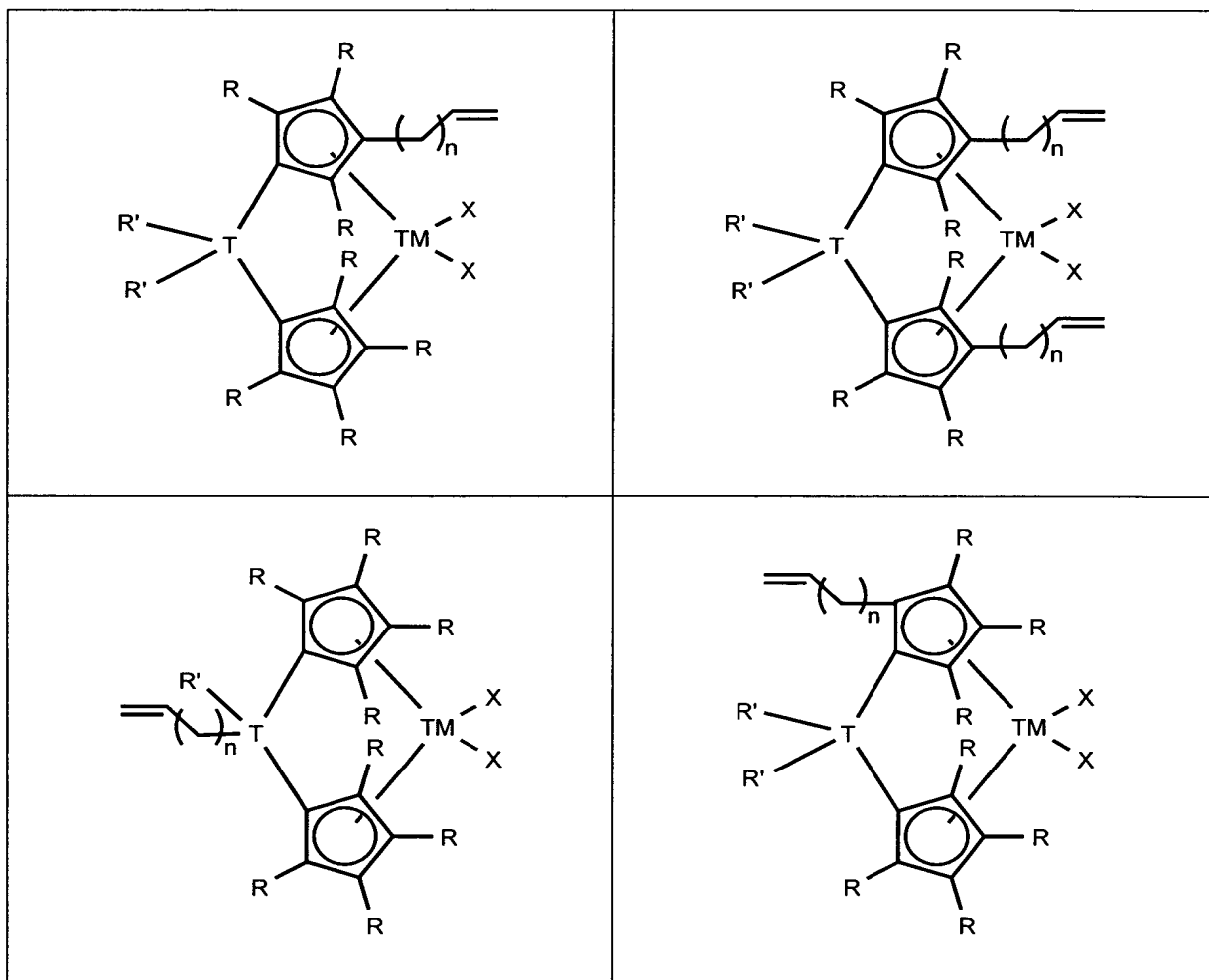
wherein each R,  $R'$ , and  $R''$  are independently selected from hydrogen or a hydrocarbyl group provided at least one of R,  $R'$ , and  $R''$  can be polymerized by a free radical initiator, provided that when  $M^1$  is Zr,  $L_A$  is substituted at more than one carbon atom.

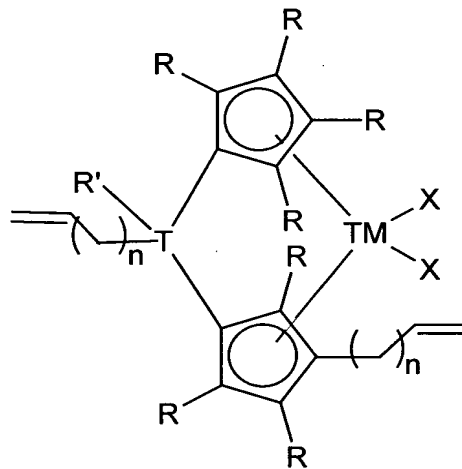
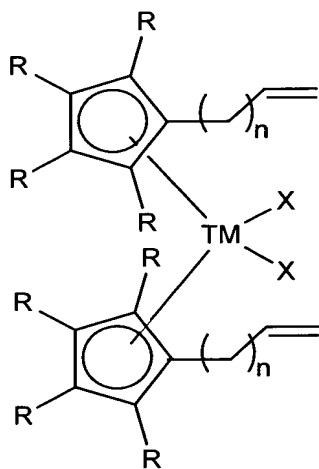
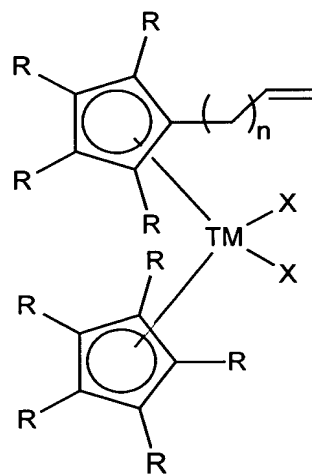
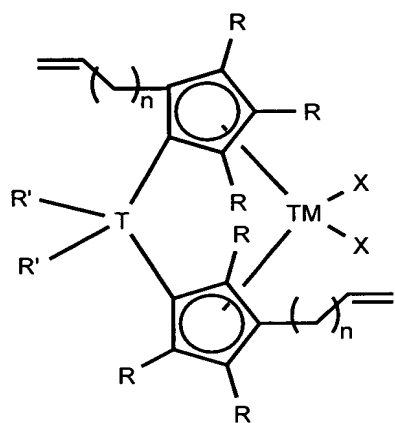
2. The composition of Claim 1 wherein each R,  $R'$ , and  $R''$  are independently selected from hydrogen or a  $C_1$ - $C_{50}$  hydrocarbyl group.
3. The composition of Claim 1 wherein each R,  $R'$ , and  $R''$  are independently selected from hydrogen or a  $C_1$ - $C_{20}$  hydrocarbyl group.
4. The composition of Claim 3 wherein each R is independently one of hydrogen, allyl, methyl, or phenyl groups.
5. The composition of Claim 3 wherein M is selected from a Group-3-7 transition metal.
6. The composition of Claim 5 wherein M is selected from a Group-3-4.

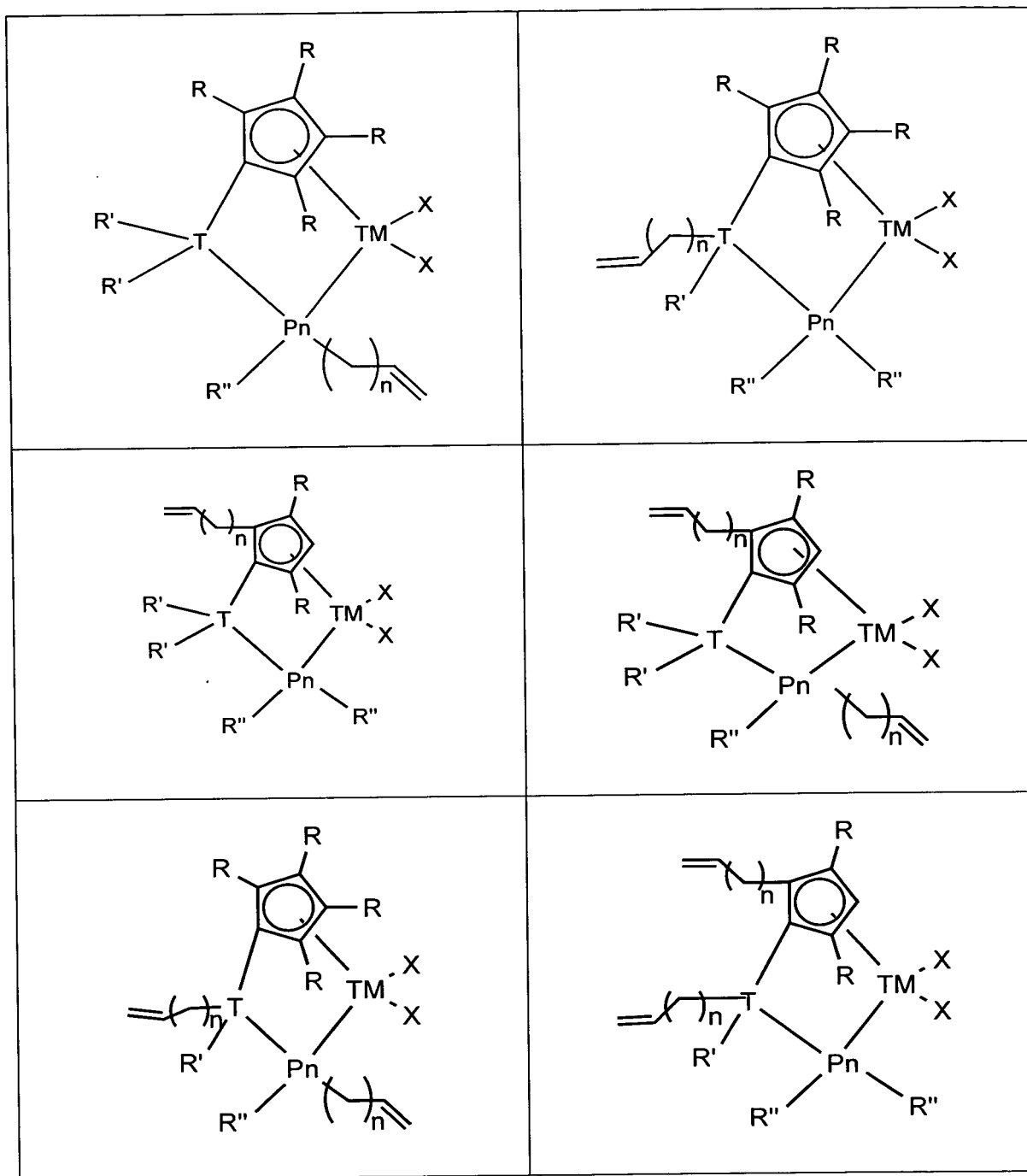
7. The composition of Claim 3 wherein the abstractable ligands are independently hydride radicals; hydrocarbyl radicals; or hydrocarbyl-substituted, organometalloid radicals.
8. The composition of Claim 7 wherein two abstractable ligands join to form a 3-to-40-atom metallacycle ring.
9. The composition of Claim 3 wherein abstractable ligands are independently halogen, alkoxide, aryloxy, amide, or phosphide radicals.
10. The composition of Claim 3 wherein abstractable ligands are chloride, bromide, iodide, methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, heneicosyl, docosyl, tricosyl, tetracosyl, pentacosyl, hexacosyl, heptacosyl, octacosyl, nonacosyl, triacontyl, hydride, phenyl, benzyl, phenethyl, tolyl, methoxy, ethoxy, propoxy, butoxy, dimethylamino, diethylamino, methylethylamino, phenoxy, benzoxy, allyl, 1,1-dimethyl allyl, 2-carboxymethyl allyl, acetylacetonate, 1,1,1,5,5,5-hexa-fluoroacetylacetonate, 1,1,1-trifluoroacetylacetonate, or 1,1,1-trifluoro-5,5-di-methylacetylacetonate radicals.
11. The composition of Claim 3 wherein at least one abstractable ligand is chloride.
12. The composition of Claim 1 wherein the at least one monomer comprises styrene, vinyl styrene, alkyl styrene, isobutylene, isoprene, or butadiene.

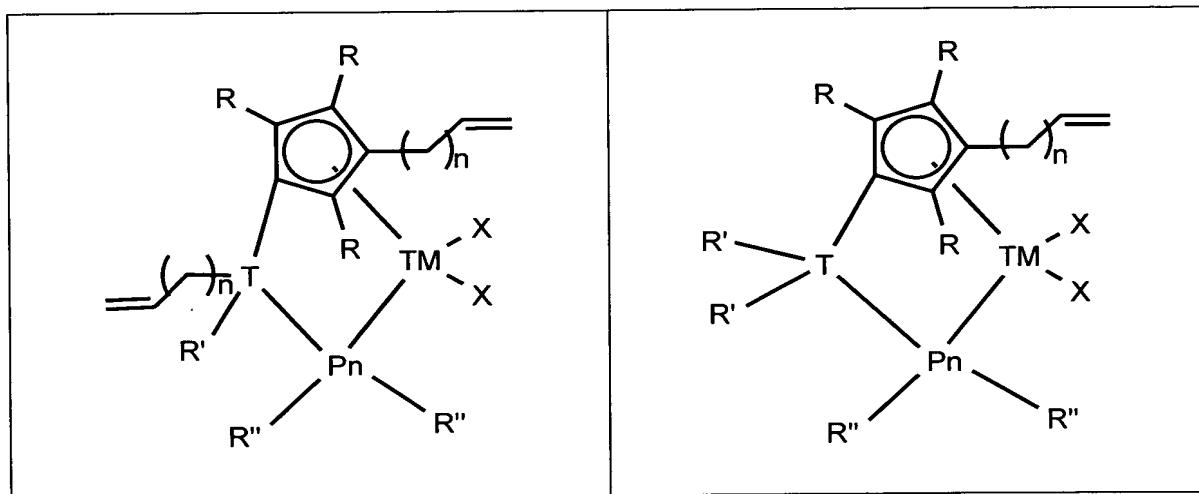
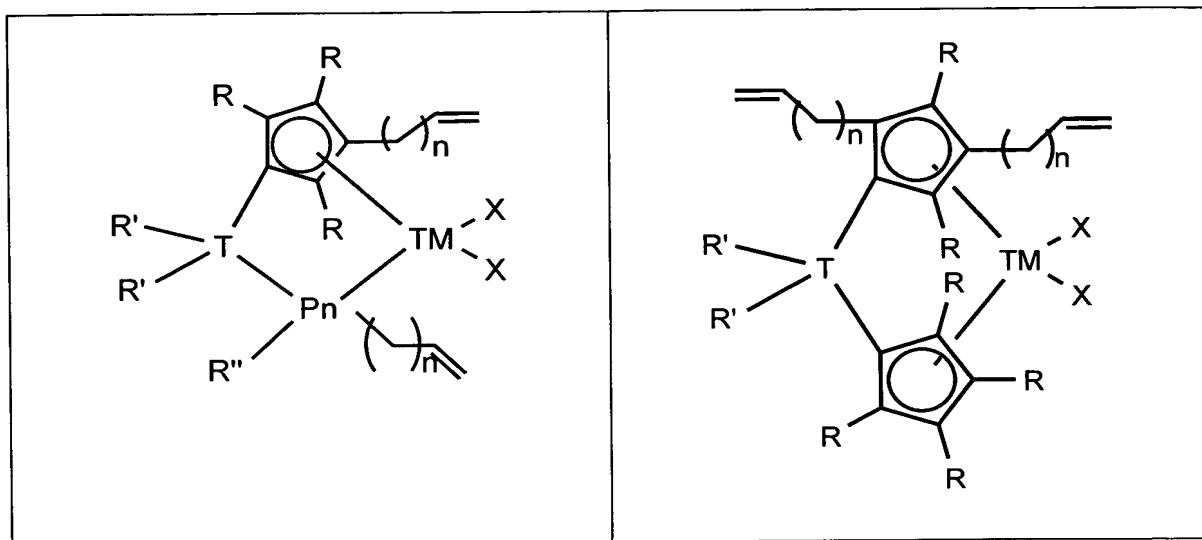
13. The composition of Claim 12 wherein the one or more monomers comprise styrene.
14. The composition of Claim 1 wherein the free radical initiator is selected from azo initiators or peroxides.
15. The composition of Claim 3 wherein the free radical initiator is selected from dialkyldiazenes, hyponitrites, diacyl peroxides, dialkyl peroxydicarbonates, peresters, alkyl hydroperoxides, dialkyl peroxides, or inorganic peroxides.
16. The composition of Claim 15 wherein the free radical initiator is selected from 2,2'-azobis(2-methylpropanenitrile), 1,1'-azobis(1-cyclohexanenitrile), 4,4'-azobis(4-cyanovaleric acid), triphenylmethylazobenzene, di-t-butyl hyponitrite, dicumyl hyponitrite, dibenzoyl peroxide, didodecanoyl peroxide, diacetyl peroxide, diisopropyl ester, dicyclohexyl ester, cumyl hydroperoxide, t-butyl hydroperoxide, dicumyl peroxide, di-t-butyl peroxide, hydrogen peroxide, and persulfate initiators.
17. A catalyst system comprising the reaction product of the composition of Claim 1 and an activator.
18. The catalyst system of Claim 17 wherein the activator is selected from alumoxanes, aluminum alkyls, alkyl aluminum halides, alkylaluminum alkoxides, discrete ionic activators, and Lewis acid activators.

19. The catalyst system of Claim 18 wherein the activator is selected from methylalumoxane, modified methylalumoxane, ethylalumoxane, trimethyl aluminum, triethyl aluminum, triisopropyl aluminum, diethyl aluminum chloride, alkylaluminum alkoxides, ammonium borate salts, phosphonium borate salts, triphenyl carbenium borate salts, ammonium aluminate salts, phosphonium aluminate salts, triphenyl carbenium aluminate salts, trisarylborane acids, and polyhalogenated heteroborane anions.
20. The composition of Claim 1 wherein the catalyst precursor is represented by one of the following formulas:

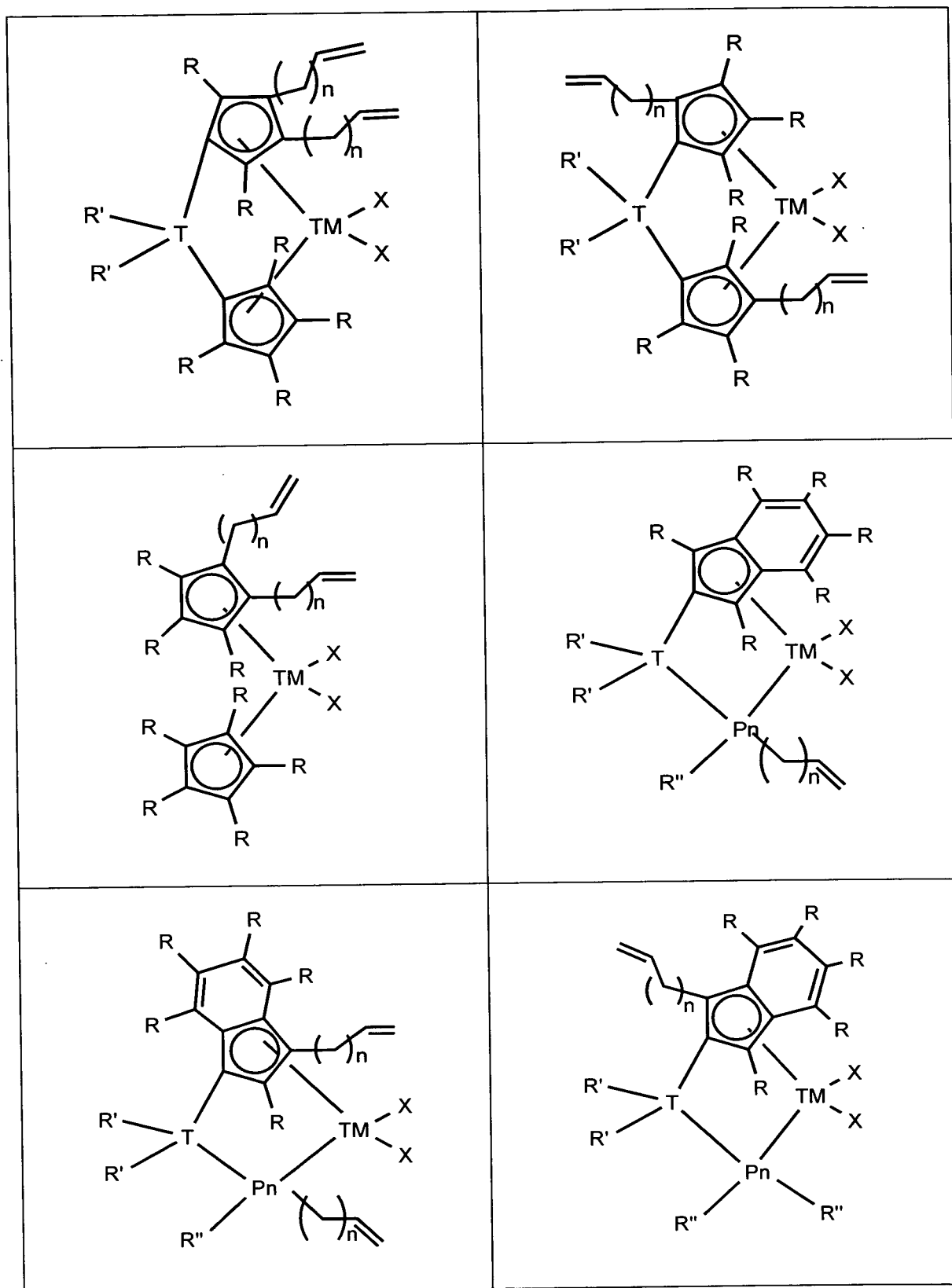


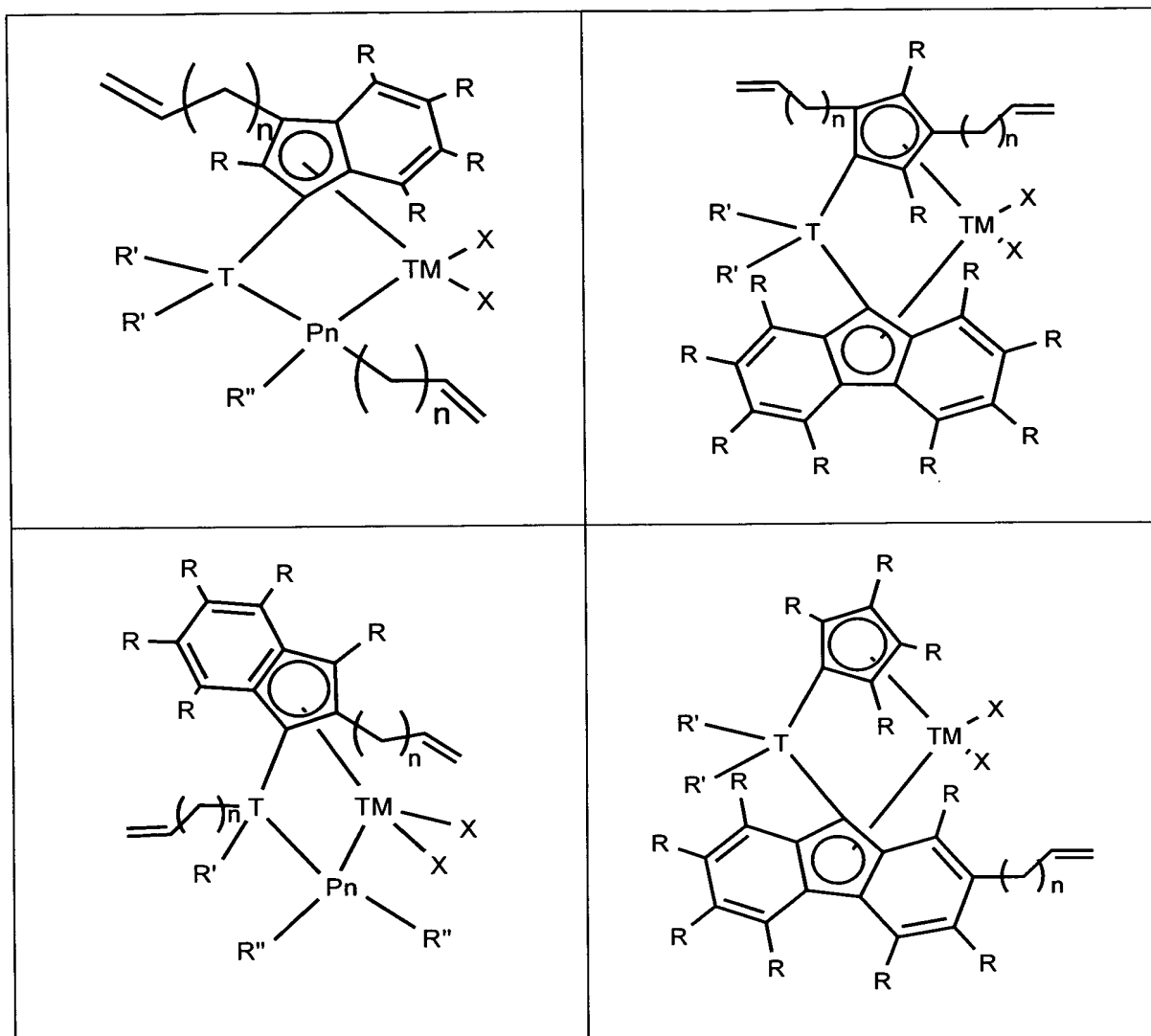


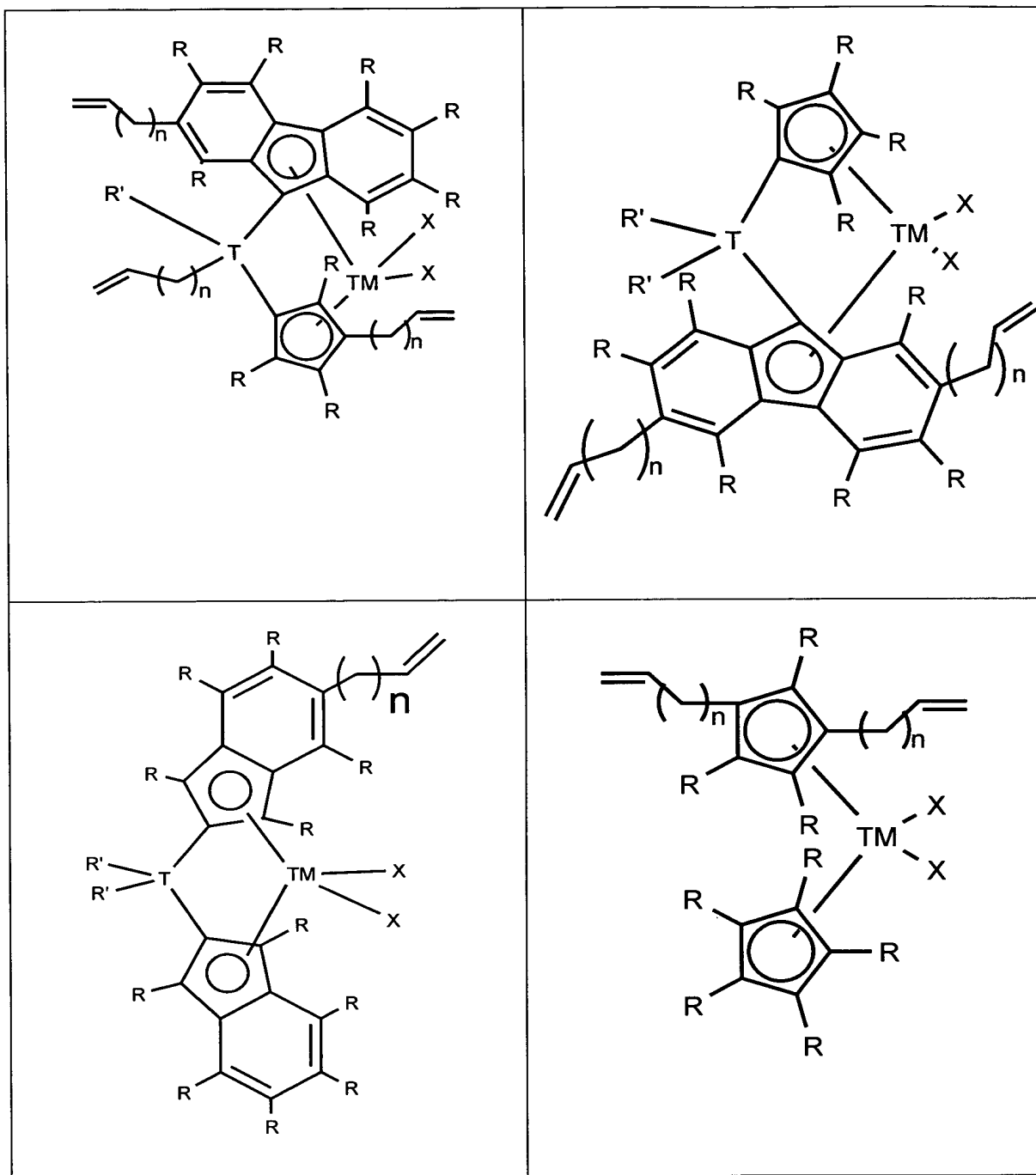


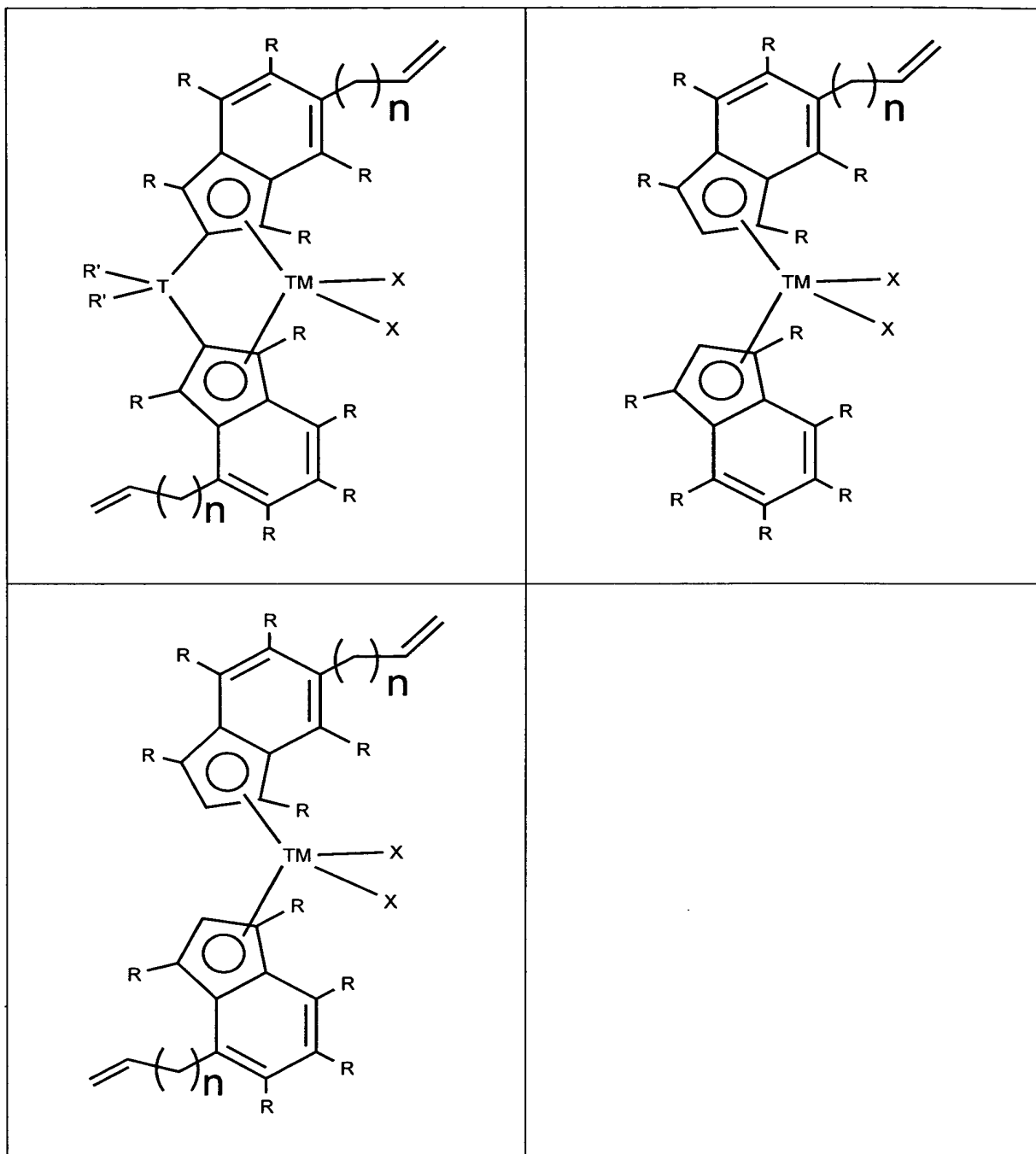












wherein

- (a)  $X$  are the same or different abstractable ligand;
- (b) Each  $R$ ,  $R'$ , and  $R''$  are independently selected from hydrogen or a hydrocarbyl group provided at least one of  $R$ ,  $R'$ , and  $R''$  can be polymerized by a free radical initiator;
- (c) TM is a Group-4-11 metal;

- (d) n is 0-3; and
- (e) Pn is a Group-14-15 atom.

- 21. An olefin polymerization method comprising the steps of combining an olefin with the composition of Claim 1, and an activator.
- 22. An olefin polymerization method comprising combining the compositional Claim 3 with an olefin and an activator, where
  - (a) the olefin monomer, and the catalyst and the activator are combined under polymerization conditions comprising:
    - (i) slurry polymerization conditions wherein slurry polymerization conditions comprise:
      - a reaction temperature of 0-120 °C;
      - a reaction pressure of 103-5068 kPa gauge;
      - a reaction media selected from C3-C7 alkanes; and
      - a primary monomer concentration of 1-10 wt% based on the total weight of monomer plus media;
    - (ii) gas-phase polymerization conditions wherein gas-phase polymerization conditions comprise:
      - a reaction temperature of 30-120 °C;
      - a reaction pressure of 69 kPa-3.5 MPa gauge; and
      - a primary monomer partial pressure of 138 kPa-2.1 MPa;
  - or
  - (iii) solution polymerization conditions wherein solution polymerization conditions comprise:
    - a reaction temperature of 0-120 °C;
    - a reaction pressure of 103-5068 kPa; and
    - a solvent selected from toluene, benzene, xylene, or hexane.